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SIGNED ORIGINAL

PROPOSED WORKPLAN -
INSTALLATION OF GROUNDWATER
MONITORING WELLS AND
SAMPLING AT THE GREENACRES
LANDFILL SITE
SPOKANE, WASHINGTON

TDD R10-8408-44

USEPA SF



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ecology and environment, inc.

108 SOUTH WASHINGTON, SUITE 302, SEATTLE, WASHINGTON 98104, TEL. 206-624-9537

International Specialists in the Environmental Sciences

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Report Prepared By: John Roland, Lazar Gorelik

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Submitted To: J.E. Osborn, Regional Project Officer
Field Operations and Technical Support Branch
U.S. Environmental Protection Agency
Region X
Seattle, Washington

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1.0 INTRODUCTION

The Greenacres Landfill site was proposed for Superfund eligibility on September 1, 1983. This action followed three years of monitoring a nearby residential well which revealed increasing levels of several volatile organic compounds (VOCs). The closed landfill is located in a former ravine and borrow pit on a hillside approximately 15 miles east of Spokane, Washington. During the 1950's the site was used as a county dump. After 1968 it was operated as a "sanitary landfill" (1). There is no record of the materials deposited there or the early methods of disposal during operation of the site. On March 31, 1972 Greenacres Landfill was closed and Spokane County sold the property.

The Rathdrum-Spokane Aquifer, which is designated as the sole source of drinking water for approximately 350,000 people in the area, is situated downgradient from the glacial deposit on which the Greenacres site is located. Localized geologic and hydrologic data is not available to confirm contamination sources or migration patterns.

A two phase approach initially stressing leachate identification and monitoring followed by monitoring and mapping of the contaminant plume is proposed. This project plan addresses the Phase I installation and sampling of leachate monitoring wells which will be constructed adjacent to and downgradient from the abandoned site. The data generated during this phase of the investigation will provide information on the geologic setting, transmissivity, water quality, groundwater gradient, and contaminant patterns which will provide the first step in the evaluation of the Greenacres Landfill as a hazardous waste site.

2.0 SITE LOCATION AND DESCRIPTION

The Greenacres site is located within Section 16, Township 25 North, Range 45 East, in Spokane County Washington. The site is approximately 15 miles east of Spokane, Washington.

The Greenacres Landfill, presently covered by vegetation, is located in a former ravine on the north slope of Carlson Hill adjacent to the Spokane Valley Aquifer (Figure 1). The landfill extends from 2100 to 2300 feet in elevation, with an average surface slope of approximately 10 percent. The lower end of the landfill is slightly above the break-in-slope between Carlson Hill and the Spokane River Valley.

The (b)(6) well appears to be directly downgradient from the landfill, located about 600 feet to the north on nearly level ground in an embayment between two bedrock spurs extending from Carlson Hill. These two spurs may be the ridge crests of the former ravine. This well has been sampled since 1981 and shows increasing levels of VOC.

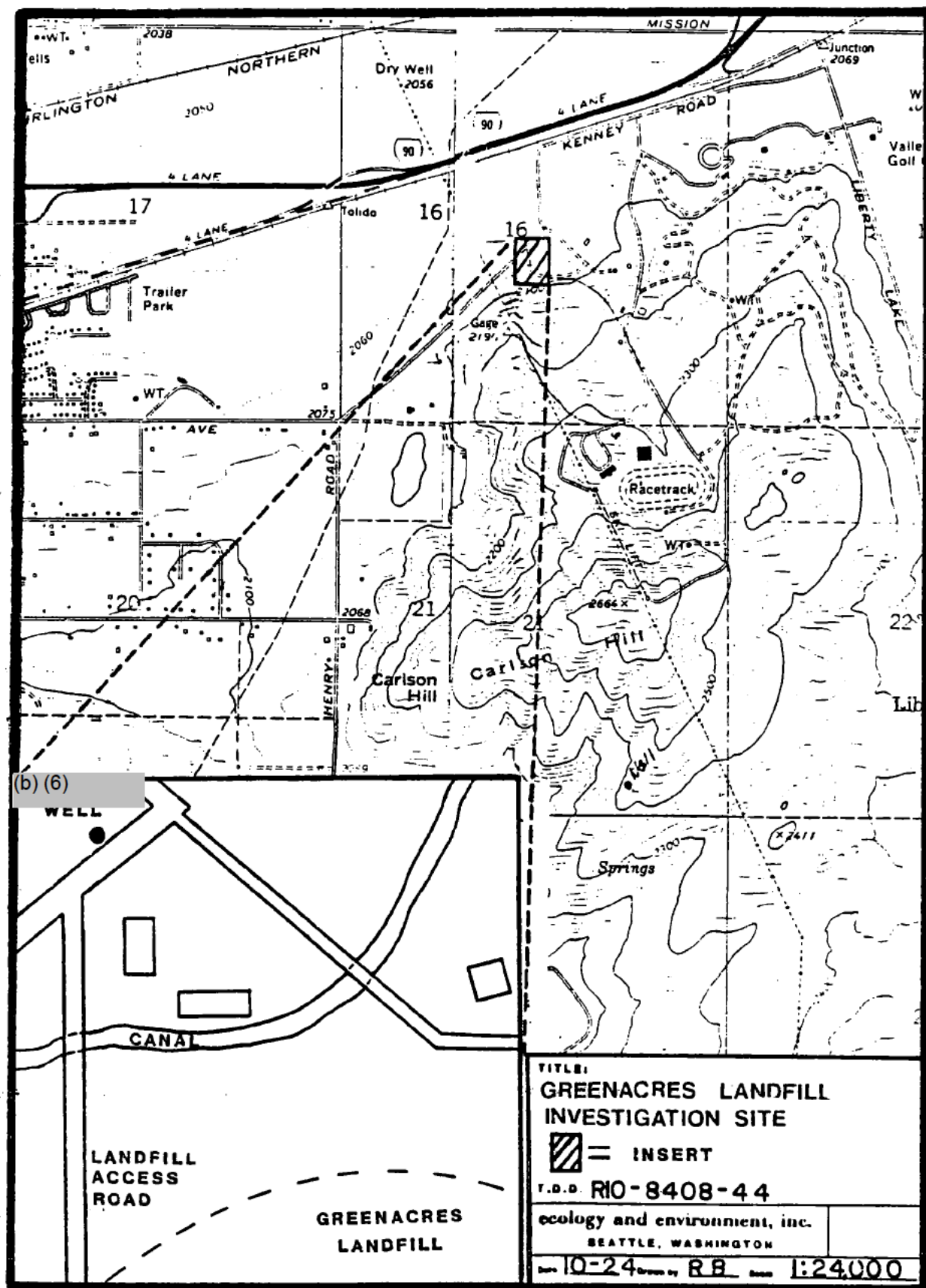


FIGURE 1

A sunken snowmobile racetrack is located upslope from the landfill at an elevation of about 2350 feet. A depression with no obvious surface discharge exists downslope from the racetrack. This area is presently being used as a dumpsite.

3.0 SITE HISTORY

Greenacres started as an uncontrolled disposal site in 1951. In 1965 or 1966 the Spokane County Health Department administered and let contracts for the operation of the disposal site. In 1968, the County Engineers Office became responsible for administration of the site and converted the operation to a sanitary landfill (1). The site was closed March 31, 1972 and Spokane County sold the property to a private developer.

The landfill formerly received up to 50,000 cubic yards per month of domestic, commercial and industrial waste from Spokane County and the surrounding area. Records of the types of waste were not kept.

The (b) (6) well has been monitored under various programs since 1973. Analytical results from these programs indicate that the chemical quality of water in the well has been considerably different from water in nearby wells.

In 1981, water in the (b) (6) well was tested for a number of synthetic organic compounds on the EPA priority pollutant list. The analytical results showed that the water contained six compounds from the group of volatile organic compounds. The total concentration of these compounds almost doubled by 1983 (2). As a result, on June 6, 1983, the Spokane County Health District advised (b) (6) not to use water from the well for cooking or drinking (3).

4.0 HYDROGEOLOGIC SETTING

The Spokane area has a semi-arid climate, with an annual precipitation of about 19.5 inches per year. The months of July and August are the driest, normally receiving less than 0.75 inch per month. Precipitation for the remaining months ranges from 1.2 inches in September to 2.7 inches in December. The normal daily average temperature increases from 25°F in January to 70°F in June (4).

Limited hydrogeologic information is available on the Greenacres site. Bedrock outcrops at numerous locations on the hillside above the landfill. The log of a well on the south side of Carlson Hill (SW 1/4, SE 1/4, Section 21, Township 25 N., Range 45 E.) shows clays, silts, sands, and gravels to a depth of 71 feet below ground surface. These deposits are underlain by 68 feet of weathered and fractured bedrock. Competent bedrock was encountered at a depth of 138 feet. The static

water level was 80 feet below the top of the well, indicating that the weathered and fractured bedrock serves as a zone for groundwater storage and/or transport.

Precipitation on the hillslope above the former ravine and infiltration from snowmelt appears to be the only source of recharge for groundwater flow through the landfill. It is unknown whether there is sufficient recharge and storage potential to produce groundwater flow year round.

No drillers log is available for the (b) (6) well. According to (b) (6), the well bottoms in fractured bedrock at a depth of approximately 185 feet with the screen placed above the bottom of the well. The static water level in the well is reported to be about 100 to 105 feet below ground surface. It is not known whether the (b) (6) well obtains most of its water from Carlson Hill or the Spokane Aquifer.

Well logs in the vicinity of the Greenacres Landfill indicate that the Spokane Aquifer in this region is composed predominantly of Quaternary glaciofluvial deposits of sand and gravel, containing scattered cobbles and boulders. Clay lenses are also present.

Most wells in this area are less than 200 feet deep and encounter water approximately 100 feet below the ground surface. According to the U.S. Geological Survey the saturated thickness of the aquifer is 50 to 100 feet. The general flow direction is westward toward the City of Spokane (5).

5.0 SCOPE OF INVESTIGATION

The investigation will be conducted in two phases. Phase I will provide initial information on the source, character and vertical extent of contamination as well as indicate the possible presence of other pollutants leaching from the landfill. Phase II will deal primarily with mapping the extent of the plume of contamination.

The purpose of this investigation is to identify and evaluate the impact of contaminants that may be leaching from the landfill into the local groundwater between the facility and the (b) (6) private well. Two monitoring wells, located near the downgradient boundary of the landfill and one upgradient well located on the hillside above the old landfill. The wells will be constructed with a single length of screen set to a depth that exhibits a high concentration of VOC. If no VOC's are detected a zone of apparent high transmissivity near the base of the unconsolidated deposits will be selected and the well constructed at this depth.

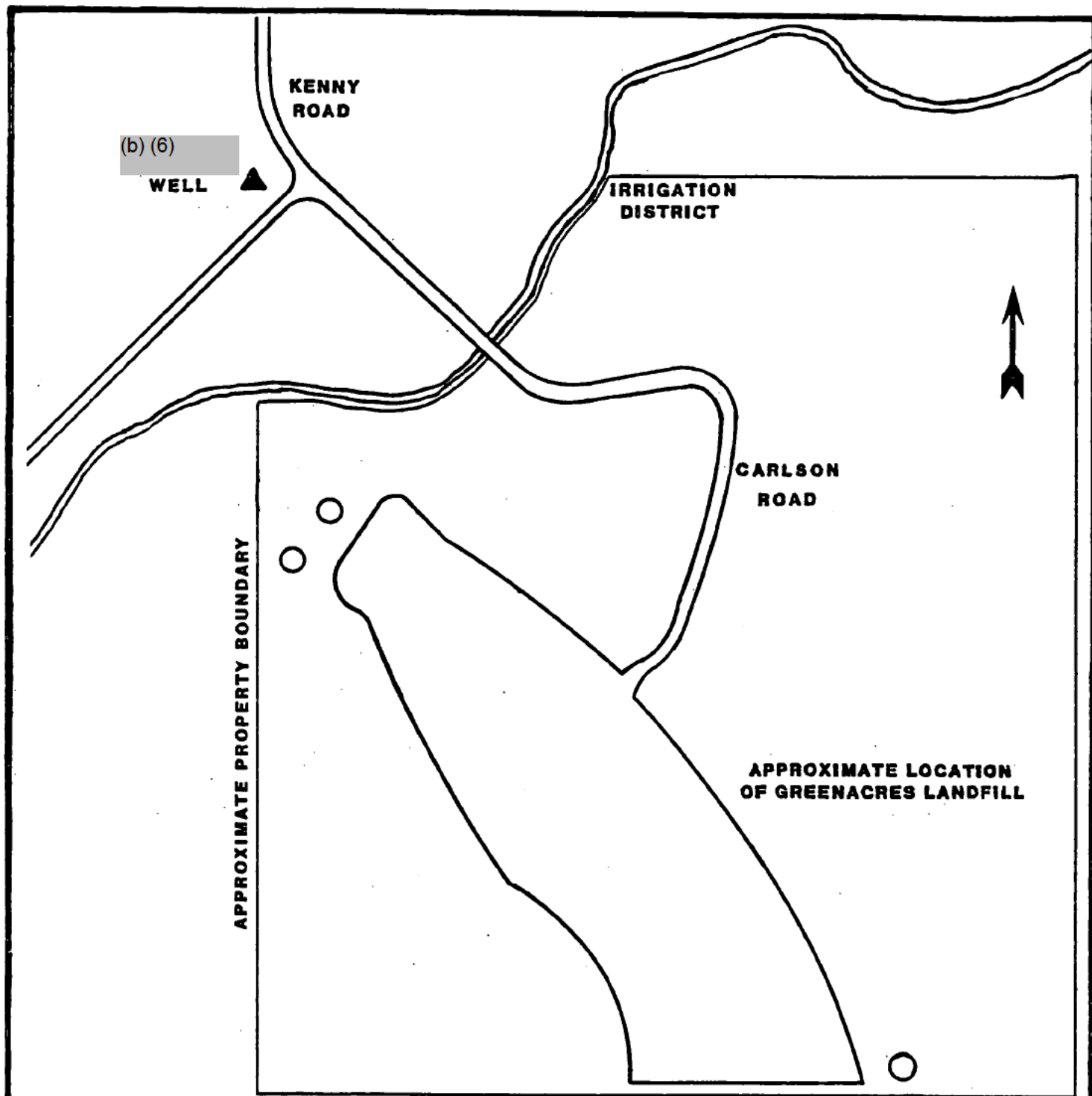
To assess the vertical distribution of pollutants at a single monitoring location groundwater samples will be collected at several depths during the drilling operations and analyzed in the field using gas chromatography. Complicating factors include the low concentration of VOCs expected, their relatively rapid migration rates, and the potential for dilution in the aquifer. Based on an analysis of the available information tentative locations identified in Figure 2 have been selected. Geologic information obtained during drilling in conjunction with analytical results from groundwater samples will provide data which will be used to determine and depths of each well.

6.0 ENVIRONMENTAL DATA ON SELECTED VOLATILE ORGANIC CHEMICALS

In order to evaluate the nature and behavior of VOCs it is important to consider some relevant properties of these compounds. From the six VOCs found in the (b) (6) well water, trichloroethylene, tetrachloroethylene, 1,2-trans dichloroethylene, and 1,2-dichloroethane have been selected for this purpose.

Trichloroethylene, tetrachloroethylene, 1,2-dichloroethylene, and 1,2-dichloroethane are commercially produced by chlorinating ethylene or acetylene; 1,2-trans-dichloroethylene is an isomer of 1,2-dichloroethylene. Trichloroethylene is a widely used ingredient in household products, dry cleaning agents, industrial metal cleaners, and polishers. Tetrachloroethylene is also used in dry cleaning and metal degreasing and is applied to polyvinyl-toluene liners in asbestos-cement pipe. This compound has a tendency to leach from polyvinyl-toluene based pipe into the ground or drinking water. Trans-1,2-dichloroethylene is sometimes used to decaffeinate coffee or as a refrigerant. The VOC, 1,2-dichloroethane is used as a solvent for oils, fats, waxes, and applied in chemical synthesis and ore floatation.

Although in recent surveys these VOCs have been found as widely encountered contaminants in drinking water supplies, there are currently no drinking water standards for these pollutants. Alternatively, EPA has developed a series of comparative criteria including Water Quality Criteria, Suggested No-Adverse Response Levels, and Recommended Maximum Contaminant Levels (6,7). The water quality criteria (WQC) for trichloroethylene, tetrachloroethylene, and 1,2-dichloroethane are presented as a range of concentrations corresponding to incremental cancer risks in populations ranging from 100,000 to 10 million (6). It is considered that the consumption of drinking water containing a concentration of 27 ug/l for trichloroethylene, 8 ug/l for tetrachloroethylene, or 9.4 ug/l for 1,2-dichloroethane may result in one additional cancer case in a population of 100,000.



KEY

○ - APPROXIMATE WELL LOCATIONS

**TITLE: APPROXIMATE LOCATIONS OF
PROPOSED MONITORING WELLS
AT GREENACRES LANDFILL**

T.S.G. R10-8408-44

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Date 10-84 Drawn by RB Scale 1"=440'

FIGURE 2

The EPA Office of Drinking Water has also developed Suggested No-Adverse Response Levels (SNARL's) for several organic contaminants. For trichloroethylene and tetrachloroethylene the toxic effect value of the SNARL was determined to be 75 ug/l and 20 ug/l, respectively. The short-term value (10 days) of the SNARL for 1,2-trans-dichloroethylene is 270 ug/l.

The EPA has recently proposed recommended maximum concentration levels (RMCL's) for a number of VOCs in drinking water (7). The agency has concluded that the RMCL for trichloroethylene, tetrachloroethylene, and 1,2-dichloroethane should be zero; for 1,1,1-trichloroethane the level was recommended to be 200 ug/l. The EPA has estimated maximum contaminant levels (MCLs) for VOCs in drinking water, concluding that these limits, which are enforceable drinking water standards range from 5 to 50 ug/l for most VOC's considered.

Table 1 is a summary of some physical-chemical properties of the target VOCs (8-10). All of these chemicals are chlorinated compounds containing two carbon atoms, with molecular weights ranging from 99 to 166. Of the four VOCs, 1,2-trans-dichloroethylene exhibits the greatest tendency for volatilization. When distilled from water solutions, trichloroethylene, tetrachloroethylene, and 1,2-dichloroethane evaporate to produce heterogeneous azeotropic mixtures, which after condensation separate into two layers; water (upper layer) and solvent (lower layer). These compounds are moderately hydrophobic and tend to partition from aqueous solutions into other phases such as gas (air) and solid (sorber). Tetrachloroethylene has the largest Henry's Constant of the four, and therefore, a greater tendency to partition in the air-water system. The octanol-water partition coefficient of tetrachloroethylene also indicates that this compound would exhibit a greater affinity to soil as compared to the three other VOCs.

Results of recent studies show that degradation of trichloroethylene and tetrachloroethylene in both a shallow water table aquifer and a deep subsurface environment will be slow. Gallahan, et al (10) have assessed the transportation and fate of the four pollutants in an aquatic system, concluding that all of them exhibit slow rates of oxidation, hydrolysis, sorption, and biodegradation. Volatilization of these pollutants from surface water is considered to be the predominant transport process.

Of particular interest to Greenacres Landfill is the effect of chemical retardation on the migration of these pollutants in subsurface media by employing the retardation equation (11).

$$\frac{\bar{V}}{V_c} = 1 + \frac{P_b}{n} K_d$$

TABLE 1
COMPARATIVE DATA FOR TRICHLOROETHYLENE,
TETRACHLOROETHYLENE, 1,2-TRANS DICHLOROETHYLENE and 1,2-DICHLOROETHANE[#]

Parameter		Trichloroethylene	Tetrachloroethylene	1,2-trans dichloroethylene	1,2-dichloroethylene
Molecular weight, g/mole		132.00	166.00	97.00	99.00
Density, g/ml		1.46	1.62	1.26	1.25
Boiling point, °C		86.7	121.00	48.00	85.50
Azeotropic point (s/water), °C*		75.1	88.5	---	72.0
Azeotropic composition*		95.7 % solvent +6.3 % water	82.8 % solvent +17.2 % water	---	88.5 % solvent 11.5 % water
Vapor pressure, mm.Hg	15°C	10.7	46.7	275.4	40
	20°C	14.0	60.0	345.0	61
	25°C	18.6	75.0	415.0	76
	30°C	24.0	90.0	500.0	105
Solubility, mg/l	15°C	---	---	---	---
	20°C	1100	150	6000	8690
	25°C	---	---	---	---
	30°C	---	---	---	---
Henry's Constant, mg/l / mg/l	15°C	0.22	0.58	---	0.02
	20°C	0.40	0.77	0.23	0.04
	25°C	0.50	1.00	0.27	0.05
	30°C	0.61	1.30	---	---
n-octanol/water partition coefficient (log K _{ow})**		2.29	2.88	1.48	1.48

[#][8]

*[9]

**[10]

where: V is the average linear velocity of the groundwater, cm/sec;
 V_c is the velocity of the concentration front of the retarded solute, cm/sec;
 K_d is the distribution coefficient of the solute, ml/g;
 P_b is the mass bulk density of soil, g/cm³;
 n is the porosity of the soil.

It has been reported that most hydrophobic organic compounds exhibit linear adsorption isotherms and that the K_d values of the compounds can be correlated against soil properties by the organic carbon content (f) in the soil (10,13).

$$K_d = K_{oc} \cdot f$$

The value of K_{oc} for a hydrophobic organic chemical can be estimated when the compound's solubility (S) or its n -octanol water partition coefficient, K_{ow} , is known.

Equations of several researchers have been used to estimate K_{oc} values for the VOCs of interest by employing data on S and K_{ow} from Table 1. The equations and the average values of K_{ow} are presented in Table 2. This table also contains the retardation factors, R , of these compounds which were determined for the site conditions by assuming the following data: $P_b = 1.7$ g/cm³, $f = 0.001$, and $n = 0.2$. The predicted values of R indicate that the VOCs are expected to migrate rapidly.

The groundwater velocities in the area of the Greenacres Landfill have been estimated by the USGS using a digital simulation model to range from 5 to 10 feet per day (5). The predicted values of R for 1, 2-trans-dichloroethylene and 1,2-dichloroethane indicate that these compounds will migrate with similar velocities as groundwater. The calculated R value for trichloroethylene, which has the highest retardation factor of the six VOCs found in the (b) (6) Well, reduces the expected TCE migration rate to be 1.3 to 2.2 feet per day.

It may be assumed that due to adsorption by unsaturated soil and potential dilution the concentrations of VOCs will be found to decrease as distance from the source increases. This may in fact be why the levels of VOCs found in the (b) (6) Well are so low. It is of critical importance therefore that the monitoring wells should be constructed in close proximity to the suspected source of contamination.

7.0 GROUNDWATER QUALITY AND SAMPLING HISTORY

The chemical quality of groundwater in the Spokane Aquifer has been a subject of investigations conducted by the U.S. Geological Survey (USGS), EPA Region X, Washington Department of Ecology of (WDOE),

TABLE 2
COMPARISON OF PREDICTED RETARDATION VALUES FOR
TRICHLOROETHYLENE, TETRACHLOROETHYLENE, 1,2-TRANS-DICHLOROETHYLENE AND 1,2-TRICHLOROETHANE

Compound	Equation	S, mg/l	log K_{ow}	K_{ow}	K_{oc}	R_{oc}	R
Trichloroethylene	*log $K_{oc} = 3.95 - 0.62 \log S$	1000	2.29	195	116	120	2.02
	*log $K_{oc} = 0.088 + 0.903 \log K_{ow}$				148		
	#log $K_{oc} = 3.64 - 0.55 \log S$				93		
	\$ $K_{oc} = 0.63 \times K_{ow}$				123		
Tetrachloroethylene	log $K_{oc} = 3.95 - 0.62 \log S$	150	2.28	758	399	410	4.5
	log $K_{oc} = 0.088 + 0.903 \log K_{ow}$				488		
	log $K_{oc} = 3.64 - 0.55 \log S$				276		
	$K_{oc} = 0.63 \times K_{ow}$				477		
1,2-trans dichloroethylene	log $K_{oc} = 3.95 - 0.62 \log S$	6000	1.48	30.2	40	30	1.26
	log $K_{oc} = 0.088 + 0.903 \log K_{ow}$				27		
	log $K_{oc} = 3.64 - 0.55 \log S$				36		
	$K_{oc} = 0.63 \times K_{ow}$				19		
1,2-Dichloroethane	log $K_{oc} = 3.95 - 0.62 \log S$	8690	1.48	30.2	32	27	1.23
	log $K_{oc} = 0.088 + 0.903 \log K_{ow}$				27		
	log $K_{oc} = 3.64 - 0.55 \log S$				30		
	$K_{oc} = 0.63 \times K_{ow}$				19		

#[12]
*[13]
\$[14]

and Spokane County Engineer's Office. Since the aquifer is designated as the sole source water supply for a population of principal objective of these investigations. The interpretation of some of the results obtained for the aquifer can be found in a number of reports (5, 16-18). USGS and EPA files provide an additional source of useful information on the chemical quality of the groundwater in the area of the Green-acres Landfill.

Analyses of heavy metals listed in the Primary Drinking Water Regulations (19), some of the Secondary Drinking Water Parameters (20) (including chloride, copper, iron, manganese, sulfate, zinc, pH, dissolved solids), and a number of conventional parameters are available for groundwater samples collected since 1973. The conventional parameters included hardness as CaCO_3 , calcium, sodium, magnesium, potassium, alkalinity, fluoride, silica, nitrogen in various forms, carbonate, bicarbonate, temperature, and specific conductance. From 1981 to 1984 a limited number of groundwater samples were also analyzed for some organic and inorganic chemicals from the EPA priority pollutant list (Appendix A). However, groundwater samples were not tested for the organic group of primary drinking water contaminants (Appendix B). Analytical results are presented in Table 3.

The data in Table 3 indicate that the chemical quality of the water in the (b) (6) Well is considerably different from that in other local wells such as 25/45-15CC1 and 25-45-17P02. These wells are located upgradient and downgradient respectively of the (b) (6) well and penetrate the valley aquifer. The concentration of dissolved solids, CaCO_3 , and manganese found in the (b) (6) well exceed the Secondary Maximum Contaminant Levels (SMCLs) while the concentrations of these parameters found in the adjacent wells do not. With the exception of temperature, manganese, and chloride, there has been no major fluctuation in water quality.

Contamination of the (b) (6) Well was suspected in 1973 when it was resampled and analyzed for a group of suspected pesticides. The analysis produced no quantifiable results for these organics. This was the only time prior to 1981 when the groundwater was tested for the presence of organic compounds. A 1978 study considering the water quality of the well suggested that the waste site could influence the chemical quality of the drinking water. It also reported an elevated mercury level of 4 ug/l in the water. When the (b) (6) well was tested for a number of organic compounds on the EPA priority pollutant list, analysis showed that the water contained six chemicals from the group of VOCs (Table 4). The combined averaged concentration of these compounds in the water was 183 ug/l. The highest concentration of 133 ug/l was found for 1,2-trans-dichloroethylene. In 1983, the concentration of this compound increased more than two times, while the concentrations of the other pollutants remained at approximately the same levels.

TABLE 3.
SELECTED GROUNDWATER QUALITY PARAMETERS FOR THE
(b) (6) WELL AND TWO OTHER LOCAL WELLS

Parameter	Well 25/45-16K01 ((b) (6)) Average Value#				Well 25/45-15D01 Average Value#		Well 25/45-17P02 Average Value#		
	1973-1977	1981	1982	1983	1971-1977		1970-1980	1981	1983
Specific Conductance, umhos	957	850	870	763	239		164	131	145
pH	6.7	6.9	7.1	6.9	7.7		7.9	8.1	7.2
Temperature, °C	14	16	14	13	12		10	12	12
Hardness as CaCO ₃ , mg/l	533*	---	---	---	135		82	---	---
Calcium as Ca, mg/l	136	---	143	152	31		23	---	29
Magnesium as Mg, mg/l	38	---	43	41	14		6	---	7
Sodium as Na, mg/l	10	---	14	12	5		3	3	3
Potassium as K, mg/l	3	4	4	4	2		2	---	3
Manganese as Mn, ug/l	<10	---	---	350	8		6	---	<10
Zinc as Zn, ug/l	120	---	---	---	52		---	---	---
Alkalinity as CaCO ₃ , mg/l	450*	---	---	---	112		72	---	---
Sulfate as SO ₄ , mg/l	12	---	17	11	13		12	15	9
Chloride as Cl, mg/l	24	65	64	60	4		1	4	2
Carbonate as CO ₃ , mg/l	0	---	---	---	---		---	---	---
Bicarbonate as HCO ₃ , mg/l	526	---	---	---	88		---	---	---
Dissolved Solids, mg/l	522*	---	---	---	148		109	---	---

= data unavailable for 1982

* = data unavailable past 1977

< = probably below detection limit

--- = data unavailable

TABLE 4
COMPARISON OF AVERAGE ANNUAL CONCENTRATIONS OF THE
SIX VOCs IN THE (b) (6) WELL FROM 1981-1983

Compound	Concentration (ug/l)				EPA Ambient Water Quality Criteria	Suggested No-Adverse Response Levels
	1981	1982	1983	Average		
1,1-dichloroethane	0.9	2.2	3.2	2.1	---	
1,2-dichloroethane	8.6	14.0	12.6	11.7	9.4(10 ⁻⁵)	
1,1,1-tri chloroethane	1.7	2.0	1.0	1.6	18,400	1,100
1-2-trans-di- chloroethylene	133	235	311.8	226.6		0.27
Tetra- chloroethylene	31.2	22.5	23.0	25.6	8(10 ⁻⁵)	20
Trichloroethelene	<u>7.7</u>	<u>9.4</u>	<u>6.6</u>	<u>7.9</u>	27(10 ⁻⁵)	75
	183.1	285.1	358.2	275.5		

The data in Table 4 indicate that the average concentration of tetrachloroethylene in the water was stable and it always exceeded the SNARL. In 1983, the average concentration of 1,2-trans-dichloroethylene in the drinking water even exceeded the short-term value (10 days) of the SNARL recommended for this compound. Taking into consideration the EPA definition of RMCLs, it appears that the aquifer in the area of the (b) (6) well has become unusable as a drinking water source.

8.0 KEY PARAMETERS

Conventional parameters, the organic and inorganic primary contaminants from the drinking water standards, and compounds from the EPA priority pollutant list have been selected as key monitoring parameters for characterizing the leachate from the landfill and chemical quality of background groundwater. The analytical results of groundwater samples from the (b) (6) well and the principal parameters that the EPA groundwater monitoring system recommended for monitoring landfills (21) have been taken into consideration in determining this set of parameters.

The key analytical parameters for groundwater samples from the developed monitoring wells to be located at the solid waste boundary and hydraulically downgradient of this facility are given below:

1. Conventional Parameters

- | | |
|--------------------|------------------------|
| o bicarbonate | o magnesium |
| o calcium | o manganese |
| o carbonate | o potassium |
| o chloride | o sodium |
| o dissolved solids | o specific conductance |
| o hardness | o sulfate |

2. Primary Drinking Water Contaminants and EPA Priority Pollutants

- a. heavy metals from the priority list and barium
- b. pesticides from the priority list and the following contaminants: methoxychlor, 2,4-D, 2,4,5-TP Silvex, toxaphene
- c. base-neutral extractables
- d. acid-extractables
- e. volatiles

The set of parameters to be used in the field for analyzing groundwater samples collected at different depths during drilling operations is presented below:

- o temperature
- o specific conductance

- o pH
- o 1,1-dichloroethane
- o 1,2-dichloroethane
- o 1,1,1-trichloroethane
- o 1,2-trans-dichloroethylene
- o trichloroethylene
- o tetrachloroethylene

The analytical results of these samples will be used in selecting the most likely contaminated zones for setting screened casing.

9.0 METHOD OF MONITORING WELL INSTALLATION

The initial phase of field work at the Greenacres Landfill site involves the installation and sampling of three monitoring wells. These wells will be located in areas likely to generate the most information regarding the source and extent of the groundwater contamination. The proposed locations are suggested based on some reasonable assumptions concerning the probable sources of contamination and the local geologic setting; specifically, that the county dump site is the most likely source of VOCs and that these contaminants are leaching downgradient towards the Spokane Valley. As the wells are constructed geologic and water quality data will be evaluated so that successive sites chosen during Phase I can be selected or rejected as more information is generated.

9.1 Drilling Technique

Due to the thickness of the unconsolidated material in which the wells will be installed, and in an effort to expedite the installation of these wells, the air-rotary method of drilling is recommended to the top of the water table. The cable tool method of drilling will be employed through the saturated portion of the aquifer. This drilling technique will greatly speed up the actual construction time for these wells, some of which may be approximately 200 feet deep. As the drilling progresses an 8-inch diameter working casing will be advanced so that no more than one foot of open hole extends ahead of it. Every effort will be made to contain the borehole fluids during drilling operations. As the drilling proceeds representative soil samples will be collected and a lithologic log compiled by an E&E geologist. All drill cuttings generated while drilling will be stored in 55-gallon drums. Use of surface casing and a circulation system will be required.

9.2 Decontamination of Drilling Equipment

Due to the nature of the sampling programs proposed, both during and after the monitoring wells are installed every effort must be made to avoid contamination or cross contamination during construction. An upgradient area of the site will be designated for decontamination of

tools and equipment. After each well is completed the working area of the rig and all drilling tools and equipment coming in contact with the borehole fluids will be cleaned to prevent cross contamination. A solution of Alconox, a laboratory detergent will be used first followed by steam cleaning. Next acetone followed by methanol will be sprayed on all surfaces likely to come in contact with borehole fluids or construction materials.

The drilling equipment, tools, and construction materials will be scrubbed with a solution of Alconox and then steam cleaned to remove all oils, grease or other lubricants. In addition, this area will be used to steam clean the drilling equipment and tools after each well is completed and before moving to the next one.

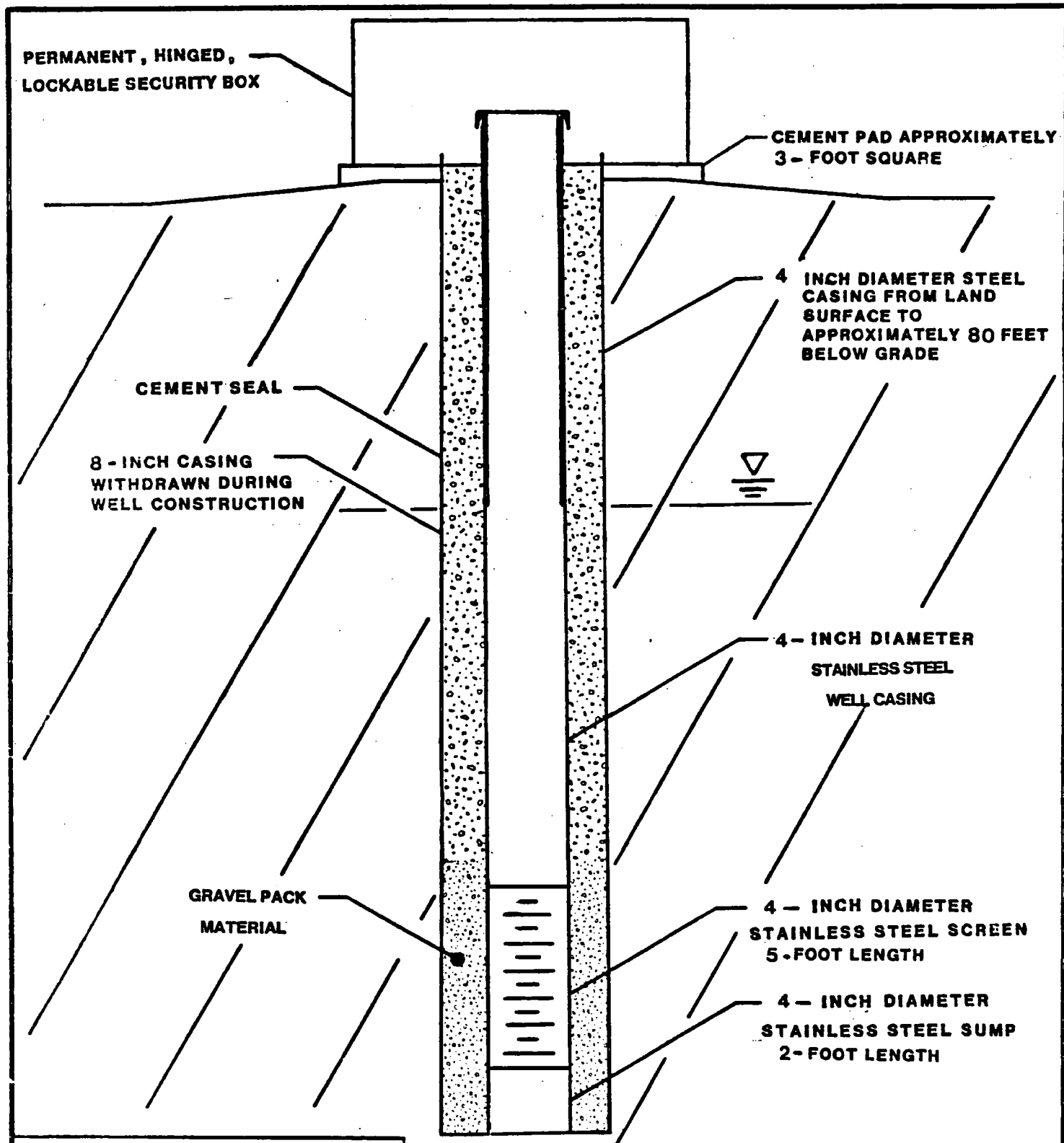
9.3 Field Screening for Selected Parameters

Although the air-rotary method of drilling may affect the utilization of some of the organic compounds the data generated should be of value in a relative sense. Field screening for selected volatile organic compounds using the Shimadzu GC Mini II portable gas chromatograph as well as field analysis for pH, conductivity and temperature will be collected at two to three intervals while drilling the initial or deepest borehole at each location. At each depth to be sampled, which will be determined based on the lithology encountered, drilling operations will halt and all drilling tools removed. The bottom of the casing will remain open to the formation. A submersible pump will then be installed and the borehole developed. After a minimum of three volumes of water have been purged a water sample will be collected for field analysis. Using these combined field analyses, zones exhibiting higher levels of contamination will be identified. The monitoring wells will then be constructed so that these zones of interest can be monitored.

9.4 Construction Details

The monitoring wells will be constructed of 4-inch diameter stainless-steel casings having a minimum 0.188-inch wall thickness in the lower portion of the well inside an 8-inch diameter borehole. At a safe height above the water table's estimated highest annual point regular 4-inch diameter steel pipe will be welded or screwed to the stainless steel casing. The conventional steel pipe will be used as the well casing from this depth back to land surface, estimated to average approximately 70 feet (Figure 3).

The stainless steel lower casings and screens are suggested as providing the longest lasting and trouble free sampling installation. It is felt that the use of PVC materials at the Greenacres site would jeopardize the integrity of the data collected during this program.



FIELD INVESTIGATIONS OF UNCONTROLLED
HAZARDOUS WASTE SITES
TASK REPORT TO THE E.P.A.

TITLE:

PROPOSED WELL CONSTRUCTION
DETAILS FOR GREENACRE LANDFILL

T.O.D. R10-8408-44

ecology and environment, inc.
SEATTLE, WASHINGTON

Date 10-84 Drawn by RB Scale NONE

FIGURE 3

The capability of PVC to leach VOCs in levels significantly higher than those found in the (b) (6) well has been documented in at least one source (22). The ability of PVC to leach these compounds in concentrations of approximately 200 micrograms per litre could raise questions concerning the validity of the data collected during this investigation.

Once the actual borehole has been drilled and sampled, a zone will be selected for screening. After the screen and casing are installed clean, graded (6-20) silica sand will be emplaced from the bottom of the zone to be monitored to a minimum height of two feet above the top of the screen. Any open hole extending below the screened zone will also be filled with gravel pack material and/or plugged with cement depending on the lithologic conditions encountered.

Immediately on top of the gravel pack a minimum two foot in depth cap of clean, fine grained, silica sand will be set. This cap should prevent any cement from entering through the top of the gravel pack.

Cementing operations will be conducted through a tremie or grout pipe initially set to a depth of within 10 feet of the top of the gravel pack. After cementing procedures begin the tremie pipe will be successively raised as the 8-inch steel casing is pulled back to insure a uniform seal from top to bottom. All fluids displaced while cementing will also be contained for testing to determine the required disposal methods.

9.5 Well Development

Surging or pumping or a combination thereof will be used to develop the wells to achieve maximum flow. The contractor shall furnish a pump with a minimum capacity of 50 gallons per minute and all other necessary pipe, hoses and fittings required for development. The wells will be developed to a sand free condition. Development time will be determined by the E&E project geologist.

9.6 Wellhead Completion

The 4-inch diameter well casing will extend at least one foot above the ground level. A permanent lockable, inverted steel box will cover the casing. The hinges and locking device shall be set into a concrete pad approximately three feet square, 0.33-foot in thickness, and constructed such that only one half of the thickness is above grade. A diagram showing complete monitoring well details is given in Figure 3. A temporary security casing or box shall be placed over the casing until the final cover has been installed.

9.7 Groundwater Sampling

After the wells are completed and developed samples will be collected from all wells for laboratory analysis of the key parameters specified.

Following the initial round of sampling after construction is completed, additional samples will be collected quarterly for at least one year. This will provide four sets of data, collected during all seasonal conditions, which should indicate trends in migration patterns and establish background data for the Phase II scoping proposal. All water samples will be collected after the individual well has been pumped a minimum of three to five times the volume of water standing inside the casing.

9.8 Proposed Storage of Drill Cuttings and Water

In addition to the water generated during drilling and development operations, all drill cuttings will be stored in 55-gallon drums or other approved receptacles. To determine whether or not the drill cuttings exhibit characteristics of hazardous waste they will be tested employing the EP Toxicity test. If pesticides or heavy metals are present in the cuttings this test will provide additional data on the mobility of these compounds. These sets of samples will be preserved in containers marked with well and depth identification.

10.0 DELIVERABLES

The Phase I effort will be presented in a final report consisting of: 1) monitoring well installation techniques, locations, and technical difficulties in constructing wells, 2) well logs, 3) first round analytical data and field screening data, 4) interpretation of the water quality and hydrogeologic regime, and 5) recommendations for Phase II drilling. The report will be submitted within three weeks of receipt of the analytical data expected in late April 1985.

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APPENDIX A
EPA PRIORITY POLLUTANTS

APPENDIX A

PRIORITY POLLUTANTS* (WITH CHEMICAL ABSTRACT SERVICE NUMBERS)

METALS		BASE-NEUTRAL EXTRACTIBLES		ACID EXTRACTIBLES	
ANTIMONY	7440-36-0	ACENAPHTHENE	83-32-9	2-CHLOROPHENOL	95-57-8
ARSENIC	7440-38-2	ACENAPHTHYLENE	208-96-8	2,4-DICHLOROPHENOL	120-83-2
BERYLLIUM	7440-41-7	ANTHRACENE	120-12-7	2,4-DIMETHYLPHENOL	105-67-9
CADMIUM	7440-43-9	BENZIDINE	92-87-5	4,6-DINITRO-O-CRESOL	534-52-1
CHROMIUM	7440-47-3	BENZO(A)ANTHRACENE	56-55-3	2,4-DINITROPHENOL	51-28-5
COPPER	7440-50-8	BENZO(A)PYRENE	50-32-8	2-NITROPHENOL	88-75-5
LEAD	7439-92-1	BENZO(B)FLUORANTHENE	205-99-2	4-NITROPHENOL	100-07-7
MERCURY	7439-97-6	BENZO(GHI)PERYLENE	191-24-2	P-CHLORO-M-CRESOL	59-50-7
NICKEL	7440-02-0	BENZO(K)FLUORANTHENE	207-08-9	PENTACHLOROPHENOL	87-86-5
SELENIUM	7782-49-2	BIS(2-CHLOROETHOXYL) METHANE	111-91-1	PHENOL	108-95-2
SILVER	7440-22-4	BIS(2-CHLOROETHYL) ETHER	111-44-4	2,4,6-TRICHLOROPHENOL	88-06-02
THALLIUM	7440-28-0	BIS(2-CHLOROISOPROPYL) ETHER	108-60-1		
ZINC	7440-66-6	BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	<u>VOLATILES</u>	
		4-BROMOPHENYL PHENYL ETHER	101-55-3		
		2-CHLORONAPHTHALENE	91-58-7	ACROLEIN	107-02-8
		CHRYSENE	218-01-9	ACRYLONITRILE	107-13-1
		4-CHLOROPHENYL PHENYL ETHER	7005-72-3	BENZENE	71-43-2
		1,2,5,6-DIBENZANTHRACENE	53-70-3	BIS(CHLOROMETHYL) ETHER	542-88-1
		1,2-DICHLOROBENZENE	95-50-1	BROMODICHLOROMETHANE	15-27-4
		1,3-DICHLOROBENZENE	541-73-1	BROMOFORM	75-25-2
		1,4-DICHLOROBENZENE	106-48-7	CARBON TETRACHLORIDE	56-23-5
		3,3-DICHLOROBENZIDINE	91-94-1	CHLOROBENZENE	108-90-7
		DIETHYL PHTHALATE	84-66-2	CHLOROETHANE	75-00-3
		DIMETHYL PHTHALATE	131-11-3	2-CHLOROETHYL VINYL ETHER	110-75-8
		DI-N-BUTYL PHTHALATE	84-74-2	CHLOROFORM	67-66-3
		2,4-DINITROTOLUENE	121-14-2	CIS-1,3-DICHLOROPROPENE	542-75-6
		2,6-DINITROTOLUENE	606-20-2	DIBROMOCHLOROMETHANE	124-48-1
		DI-N-OCTYL PHTHALATE	117-81-7	DICHLOROFLUOROMETHANE	75-71-8
		1,2-DIPHENYLHYDRAZINE	122-66-7	1,1-DICHLOROETHANE	75-34-3
		FLUORANTHENE	206-44-0	1,2-DICHLOROETHANE	107-06-2
		FLUORENE	86-73-7	1,1-DICHLOROETHYLENE	75-35-4
		HEXACHLOROBENZENE	118-74-1	1,2-DICHLOROPROPANE	78-87-5
		HEXACHLOROBUTADIENE	87-68-3	ETHYLBENZENE	100-41-4
		HEXACHLOROCYCLOPENTADIENE	77-47-4	METHYL BROMIDE	74-83-9
		HEXACHLOROETHANE	67-72-1	METHYL CHLORIDE	74-87-3
		INDENO(1,2,3-CD)PYRENE	193-39-5	METHYLENE CHLORIDE	75-09-2
		ISOPHORONE	78-59-1	1,1,2,2-TETRACHLOROETHANE	79-34-5
		NAPHTHALENE	91-20-3	TETRACHLOROETHYLENE	127-18-4
		N-BUTYL BENZYL PHTHALATE	85-68-7	1,2-TRANS-DICHLOROETHYLENE	540-59-0
		NITROBENZENE	98-95-3	TRANS-1,3-DICHLOROPROPENE	10061-02-6
		N-NITROSODIMETHYLAMINE	62-75-9	1,1,2-TRICHLOROETHANE	79-00-5
		N-NITROSODI-N-PROPYLAMINE	621-64-7	TRICHLOROETHYLENE	79-01-6
		N-NITROSODIPHENYLAMINE	86-30-6	TRICHLOROFLUOROMETHANE	75-69-4
		PHENANTHRENE	85-01-8	1,1,1-TRICHLOROETHANE	71-55-6
		PYRENE	129-00-0	TOLUENE	108-88-3
		TCDD	1746-01-6	VINYL CHLORIDE	75-01-4
		1,2,4-TRICHLOROBENZENE	120-82-1		
<u>PESTICIDES</u>					
ALDRIN	309-00-2				
ALPHA BHC	319-84-6				
BETA BHC	319-85-7				
GAMMA BHC	58-89-9				
DELTA BHC	319-86-8				
CHLORDANE	5103-71-9				
4,4-DDD	72-54-8				
4,4-DDE	72-55-9				
4,4-DDT	50-29-3				
DIELDRIN	60-57-1				
ALPHA ENDOSULFAN	115-29-7				
BETA ENDOSULFAN	115-29-7				
ENDOSULFAN SULFATE	1031-07-8				
ENDRIN	72-20-8				
ENDRIN ALDEHYDE	7421-93-4				
HEPTACHLOR	76-44-8				
HEPTACHLOR EPOXIDE	1024-57-3				
PCB 1016	12674-11-2				
PCB 1221	111-042-82				
PCB 1232	111-411-65				
PCB 1242	534-692-19				
PCB 1248	126-722-96				
PCB 1254	110-916-91				
PCB 1260	110-968-25				
TOXAPHENE	8001-35-2				
<u>MISCELLANEOUS</u>					
CYANIDE	57-12-5				

*LIST COMPILED BY EPA

APPENDIX B
EPA INTERIM PRIMARY DRINKING WATER STANDARDS

APPENDIX B

EPA INTERIM PRIMARY DRINKING WATER STANDARDS

Parameter	Maximum Level (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Fluoride	1.4-2.4
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP Silvex	0.01

[Comment: Turbidity is applicable only to surface water supplies.]

APPENDIX C
SAMPLING WORKPLAN

APPENDIX C

SAMPLING WORKPLAN
GREENACRES LANDFILL
GROUNDWATER MONITORING PROGRAM
SPOKANE, WASHINGTON

TDD R10-8408-44

Report Prepared By: John Roland, Lazar Gorelik

Draft Report Date: March, 1985

Submitted To: J.E. Osborn, Regional Project Officer
Field Operations and Technical Support Branch
U.S. Environmental Protection Agency
Region X
Seattle, Washington

1.0 TYPES OF SAMPLES

Two types of samples will be collected during the Greenacres field investigation; samples for field screening and samples to be sent to Contract Laboratory Program (CLP) laboratories. The field samples will be collected from two to three zones during the drilling of each well and analyzed onsite with a portable gas chromatograph to aid in the placement of well screens. The laboratory samples will be collected at the completion of the project from all of the new wells and quarterly thereafter for a period of one year. Samples will be classified as environmental samples where a compound may comprises less than 1.0 percent of the total sample. The classification of the laboratory samples will be determined in the field following the analysis of the field samples and handled accordingly.

2.0 NUMBER OF SAMPLES

The total number of samples proposed to be taken during the Greenacres field investigation are summarized in Table 1. One transfer blank and one transport blank will be sent to the laboratory for each sampling activity per case lot of sampling containers, and one volatile trip blank will be supplied per sample shipment. One duplicate sample will be taken per 10 samples for each sampling activity.

TABLE 1
SUMMARY OF SAMPLING ACTIVITIES

Sampling Activity	Estimated Total No. of Samples	Duplicates	Transfer/ Transport Blanks	Total Number Collected
Field Samples	6-8	1	2	6
Laboratory Samples	<u>4</u>	<u>1</u>	<u>2</u>	<u>7</u>
	10-12	2	4	13

*Used upper value from samples in total.

Laboratory samples will be analyzed through the CLP Special Analytical Services (SAS) for the parameters listed below (Table 2). Field sampling parameters will be selected chlorinated volatile organics found in highest concentration.

3.0 SAMPLE LABELING AND NUMBERING SYSTEM

3.1 Field Labels

All sample containers will be labelled immediately after they are filled at the sampling site. For the field samples, the label will indicate the sample number, date and time taken, the sampler's initials, and other appropriate remarks. Each label will be filled out in water-proof ink and affixed to the sample container with clear waterproof tape.

TABLE 2
LABORATORY SAMPLE PARAMETERS

Sample Type	Detection Limit
<u>EPA Priority Pollutants</u>	
Heavy Metals and Barium	Below EPA drinking water standards (Appendix B) 2.0 ug/l
Pesticides and 2,4-D; 2,4,5-TP, methoxychlor, toxaphene	<1.0 ug/l
Base/Neutral Acids	Standard I.F.B. limits
Volatiles	<1.0 ug/l
<u>Conventional Parameters§</u>	
Alkalinity (bicarbonate/carbonate)	1.0 mg/l
Calcium	0.1 mg/l
Chloride	1.0 mg/l
Dissolved solids	10.0 mg/l
Hardness	1.0 mg/l
Magnesium	0.001 mg/l
Manganese	0.2 ug/l
Sodium	0.2 ug/l
Sulfate	3.0 mg/l

§Methods for Chemical Analysis of Water and Waste,
EPA-600/4-79-020, Revised March 1983.

*Company Sales Brochure.

For the laboratory samples, the sample number labels from the CLP Traffic Report Form will be affixed to the sample container as will be a CLP Sample Tag (Figure 1 - figures appear after text) with clear water-proof tape.

3.2 Sample Numbering System

A sample numbering system will be used to identify each collected sample. Sample numbers will be written on field labels and recorded in the appropriate project and field log books to facilitate retrieval and cross-referencing of sample information. Each sample number will be composed of four components as described below:

- o Project Identification Code - All samples collected during this project will be identified with the two-digit alpha code GA.
- o Sample Location - A numeric code will be used to identify each sample location. Sample locations will be consecutively numbered as they are drilled.
- o Sample Depth - A numeric code will be used to identify each sample depth. Sample depth will be measured as the well is drilled.
- o Serial Number - A numeric code will be used as the sample number component to identify blanks. The following codes will be used:

TF - transfer blank,
TB - transport blank,

Examples of sample numbers:

GA-01-35: Greenacres, well number 1, collected at a depth of 35 feet.

GA-10-TF: Greenacres, well number 10, transfer blank.

4.0 SAMPLE DOCUMENTATION

All samples will be recorded in a field book and on a field documentation form (Figure 2) when collected. Sample custody seals (Figure 3) will be placed on all sample and shipping containers after the containers have been filled. Samples sent to the CLP laboratories will be accompanied by EPA Region X Chain-of-Custody Records (Figure 3), CLP Traffic Reports (Figure 4 and 5) and any other pertinent shipping/sample documentation. These forms will be placed in a ziplock bag and taped to the inside lid of the ice chests.

5.0 SAMPLE CONTAINERS AND SAMPLE PRESERVATION

Required sample containers and filling instructions for the laboratory samples are summarized for each sample type in Figure 6 to 9.

6.0 SAMPLE PACKAGING AND SHIPPING

As stated in Section 1.0, the level of hazard for the laboratory samples will be decided in the field following the analysis of the field samples. If it is determined that the samples contain low levels of contaminants, then they will be considered environmental samples, and handled as such (Figure 10 and 11). Samples will be put into ziplock bags, a second plastic bag, and finally into a steel ice chest. Vermiculite will be added as a shock/leakage absorption material in the plastic bag. Ice will be placed on the outside of the plastic bag in an effort to preserve the samples until they are shipped. As specified in the User's Guide to the Contract Laboratory Program, July 1984, all ice and melted water will be removed from the ice chests prior to shipping. If it is determined that the samples contain medium levels of contaminants, then they will be handled as medium hazard samples (Figure 11 and 12).

The samples will be collected and shipped in such a manner as to ensure their delivery, by an overnight carrier, to a CLP laboratory within 24 hours of collection. Figure 13 is a summary of information that will be given to the Sample Management Office (SMO) immediately upon the shipment of samples.

7.0 DECONTAMINATION AND SAFETY CONSIDERATIONS

All sampling equipment will be decontaminated prior to the collection of each sample as follows:

- o clean water wash,
- o decontamination solution wash,
- o clean water rinse,
- o acetone rinse,
- o methanol rinse,
- o distilled water rinse.

Personnel decontamination will be discussed in the Field Investigation Health and Safety Plan.

During the sampling of the boreholes and monitoring wells an HNU Photoionizer will be utilized to check for volatile organic emissions. If high readings of volatiles are detected, appropriate safety actions will be taken in accordance with the specifications of the Field Investigation Health and Safety Plan.

8.0 FIELD EQUIPMENT AND CALIBRATION

Field measurements will be made of pH, Eh, conductivity, and temperature as groundwater and surface water samples are collected. All field measurements and calibration checks will be recorded in the appropriate field log books.

A Yellow Springs Instruments (YSI) Company conductivity meter Model 33 S-C-T will be utilized. The instrument will be calibrated according to the manufacturers recommendations with a two-point check prior to leaving the office and with a one-point check before each sample is analyzed. Two standard calibration solutions of different concentrations will be made available for field calibration.

An Orion Research Company pH meter Model 211 will be used in field pH measurements. The meter will be calibrated according to the manufacturers recommendations with a two-point check prior to field work. Three standard calibration solutions (acidic, neutral, and basic) will be taken in the field for calibration checks.

Before any samples are run an initial calibration curve for the six compounds of interest will be determined at five concentrations. As continuing calibration check, 10% of the field samples will be spiked with a stock spiking solution. Precision information will be generated by running duplicates of 10% of all field samples.

9.0 SPECIFIC SAMPLING METHODOLOGIES

Field Samples

Groundwater samples will be collected at two to three interval while drilling the borehole at each location. Precise sample locations will be determined by an E&E geologist in the field based on the lithology encountered. At each sample location, drilling operations will halt and all drilling tools will be removed. The working casing, advanced as the hole is drilled as described in Section 4.4, will be situated so that the bottom two feet of the borehole is open to formation materials. A submersible pump will be set in the borehole by the subcontractor and the open hole will be developed. After a minimum of three volumes of standing water are purged, the E&E geologist will collect a groundwater sample for field screening.

Sample containers and the sampler's gloves will be rinsed with the water to be analyzed. After the sample is collected, the subcontractor will remove the pump and resume drilling activities. Sampler's gloves and the submersible pump will be thoroughly rinsed between each sample. Photographs will be taken of the sampling procedure and recorded on a Photograph Identification Sheet (Figure 14). By this method zones exhibiting elevated levels of contamination will be identified.

10.0 LABORATORY SAMPLES

Groundwater samples will be collected using a stainless steel bailer. Whenever possible, 3 to 5 times the volume of water originally standing in the wells will be purged using a pump supplied by the contractor prior to sample collection. Sample containers and the sampler's gloves will be rinsed with the water to be analyzed. Static water levels will be measured in each well with an electric water level indicator prior to purging and recording (Figure 13). The water level indicator wire will be thoroughly washed between each measurement. All purged water will be containerized and stored until the samples have been analyzed and the appropriate method of disposal is decided. Photographs will be taken of the sampling procedure.

Figures 16-20 contain a General Equipment Checklist that will be used to organize items needed for this project.

11.0 DISPOSAL OF INVESTIGATION-DERIVED WASTES

Since the level of hazard has not been determined for this site, all investigation derived wastes (solvex gloves, poly-coated tyvek, paper towels, etc) will be placed in 55-gallon drums and stored onsite until the level of hazard has been determined and an appropriate method of disposal is decided.



☆ GPO 1983 793-642



Project Code	Station No.	Month/Day/Year	Time	Designate:	
				Comp	Grab
Station Location		Samplers (Signatures)		Preservative: Yes <input type="checkbox"/> No <input type="checkbox"/>	
				ANALYSES	
Remarks:		BOD		Anions	
		Solids		(TSS) (TDS) (SS)	
		COD, TOC, Nutrients			
		Phenolics			
		Mercury			
		Metals			
		Cyanide			
		Oil and Grease			
		Organics GC/MS			
		Priority Pollutants			
		Volatile Organics			
		Pesticides			
		Mutagenicity			
		Bacteriology			
Tag No		Lab Sample No.			
10-09059					

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 10
1200 6th Avenue
Seattle, Washington 98101



FIGURE 1
CLP SAMPLE TAG

SAMPLE NO.	DATE	TEST BROKEN BY	DATE
SIGNATURE			
PRINT NAME AND TITLE (Inspector, Analyst or Technician)			

EPA FORM
7500-2 (R7-75)

**United States
Environmental Protection
Agency**

Region 10
1200 Sixth Avenue
Seattle WA 98101

CHAIN OF CUSTODY RECORD

[illegible]

Distribution. Original - Accompany Shipment
One Copy - Survey Coordinator Field Files

EPA X-91

FIGURE 3



U.S. ENVIRONMENTAL PROTECTION AGENCY HAWAII Sample Management Office

710 5th St. Honolulu HI 96824-7100 FAX: 710 557-7991

INORGANICS TRAINING REPORT

Sample Number
MJ 9369

① Case Number: _____ Sample Site Name/Code: _____ _____ _____		② SAMPLE CONCENTRATION (Check One) <input type="checkbox"/> Low Concentration <input type="checkbox"/> Medium Concentration ③ SAMPLE MATRIX (Check One) <input type="checkbox"/> Water <input type="checkbox"/> Soil/Sediment	④ Ship To: Attn: _____ Transfer Ship To: _____
⑤ Sampling Office: _____ Sampling Personnel: Name: _____ Phone: _____ Sampling Date: _____ (Begin) _____ (End) _____		⑥ Shipping Information: Name Of Carrier: _____ Date Shipped: _____ Airbill Number: _____	
⑦ Sample Description: (Check One) <input type="checkbox"/> Surface Water <input type="checkbox"/> Ground Water <input type="checkbox"/> Leachate <input type="checkbox"/> Mixed Media <input type="checkbox"/> Solids <input type="checkbox"/> Other _____ (specify) MATCHES ORGANIC SAMPLE NO. _____		⑧ Mark Volume Level On Sample Bottle Check Analysis required <input type="checkbox"/> Task 1 & 2 <input type="checkbox"/> Task 3 Ammonia Sulfide Cyanide <input type="checkbox"/> TOC <input type="checkbox"/> Fluoride & pH	

SMO COPY

MJ 9369	- Task 1 & 2
MJ 9369	- Task 1 & 2
MJ 9369	- Task 3
MJ 9369	- Task 3
MJ 9369	- Task 3
MJ 9369	- Task 3
MJ 9369	- Task 3

FIGURE 4



ORGANICS TRAFFIC REPORT

① Case Number: _____ Sample Site Name/Code: _____ _____ _____		② SAMPLE CONCENTRATION (Check One) <input type="checkbox"/> Low Concentration <input type="checkbox"/> Medium Concentration ③ SAMPLE MATRIX (Check One) <input type="checkbox"/> Water <input type="checkbox"/> Soil/Sediment		④ Ship To: Attn: _____ Transfer Ship To: _____	
⑤ Regional Office: _____ Sampling Personnel: _____ (Name) _____ (Phone) Sampling Date: _____ (Begin) (End)		⑥ For each sample collected specify number of containers used and mark volume level on each bottle.			
				J 3707	- Water (Extractable)
				J 3707	- Water (Extractable)
				J 3707	- Water (Extractable)
				J 3707	- Water (Extractable)
				J 3707	- Water (VOA)
				J 3707	- Water (VOA)
				J 3707	- Soil/Sediment (Ext & VOA)
				J 3707	- Soil/Sediment (Ext & VOA)
				J 3707	- Water (Ext & VOA)
				J 3707	- Water (Ext & VOA)

⑦ Shipping Information Name of Carrier _____ Date Shipped: _____ Airbill Number: _____	Water (Extractable)			J 3707	- Water (Extractable)
	Water (VOA)			J 3707	- Water (VOA)
	Soil/Sediment			J 3707	- Water (VOA)
	Water (Ext/VOA)			J 3707	- Soil/Sediment (Ext & VOA)
	Other			J 3707	- Soil/Sediment (Ext & VOA)
				J 3707	- Water (Ext & VOA)

⑧ Sample Description <input type="checkbox"/> Surface Water <input type="checkbox"/> Mixed Media <input type="checkbox"/> Ground Water <input type="checkbox"/> Solids <input type="checkbox"/> Leachate <input type="checkbox"/> Other (specify) _____		⑨ Sample L J 3707 J 3707 - Water (Ext & VOA)
---	--	--

⑩ Special Handling Instructions: (e.g., safety precautions, hazardous nature)

FIGURE 5

C-11

ORGANIC SAMPLE COLLECTION REQUIREMENTS

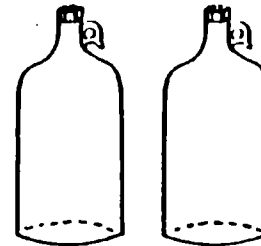
WATER SAMPLES

REQUIRED VOLUME

CONTAINER TYPE

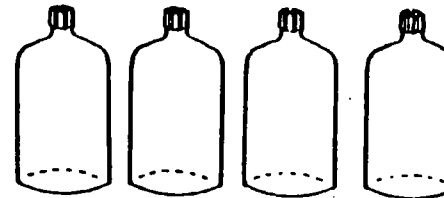
EXTRACTABLE ANALYSIS
(LOW LEVEL)

1 GALLON



2 X 1/2-GAL. AMBER
GLASS BOTTLES

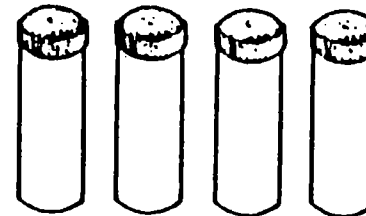
OR



4 X 1-LITER AMBER
GLASS BOTTLES

EXTRACTABLE ANALYSIS
(MEDIUM LEVEL*)

1 GALLON



4 X 32-OZ. WIDE-MOUTH
GLASS JARS

VOLATILE ANALYSIS
(LOW OR MEDIUM LEVEL*)

80 ML



2 X 40-ML GLASS VIALS

*ALL MEDIUM LEVEL SAMPLES TO BE SEALED IN METAL PAINT CAN FOR SHIPMENT



FIGURE 6

ORGANIC SAMPLE COLLECTION REQUIREMENTS


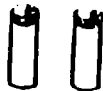


<u>SOIL/SEDIMENT SAMPLES</u>	<u>REQUIRED VOLUME</u>		<u>CONTAINER TYPE</u>
EXTRACTABLE ANALYSIS (LOW OR MEDIUM LEVEL*)	6 OZ.		1 X 8-OZ. WIDE-MOUTH GLASS JAR
			OR
			2 X 4-OZ. WIDE-MOUTH GLASS JARS
VOLATILE ANALYSIS (LOW OR MEDIUM LEVEL*)	240 ML		2 X 120-ML WIDE-MOUTH GLASS VIALS
*ALL MEDIUM LEVEL SAMPLES TO BE SEALED IN METAL PAINT CAN FOR SHIPMENT			

FIGURE 7

INORGANIC SAMPLE COLLECTION REQUIREMENTS








<u>WATER SAMPLES</u>	<u>REQUIRED VOLUME</u>		<u>CONTAINER TYPE</u>
METALS ANALYSIS (LOW LEVEL)	1 LITER		1 X 1-LITER POLYETHYLENE BOTTLE
METALS ANALYSIS (MEDIUM LEVEL*)	16 OZ.		1 X 16-OZ. WIDE-MOUTH GLASS JAR
CYANIDE (CN ⁻) ANALYSIS (LOW LEVEL)	1 LITER		1 X 1-LITER POLYETHYLENE BOTTLE
CYANIDE (CN ⁻) ANALYSIS (MEDIUM LEVEL*)	16 OZ.		1 X 16-OZ. WIDE-MOUTH GLASS JAR
*ALL MEDIUM LEVEL SAMPLES TO BE SEALED IN METAL PAINT CAN FOR SHIPMENT			

FIGURE 8

INORGANIC SAMPLE COLLECTION REQUIREMENTS

<u>SOIL/SEDIMENT SAMPLES</u>	<u>REQUIRED VOLUME</u>		<u>CONTAINER TYPE</u>
METALS AND CYANIDE (CN ⁻) ANALYSIS (LOW OR MEDIUM LEVEL*)	6 OZ.		1 X 8-OZ. WIDE-MOUTH GLASS JAR
			OR
			2 X 4-OZ. WIDE-MOUTH GLASS JARS

*ALL MEDIUM LEVEL SAMPLES TO BE SEALED
IN METAL PAINT CAN FOR SHIPMENT



FIGURE 9

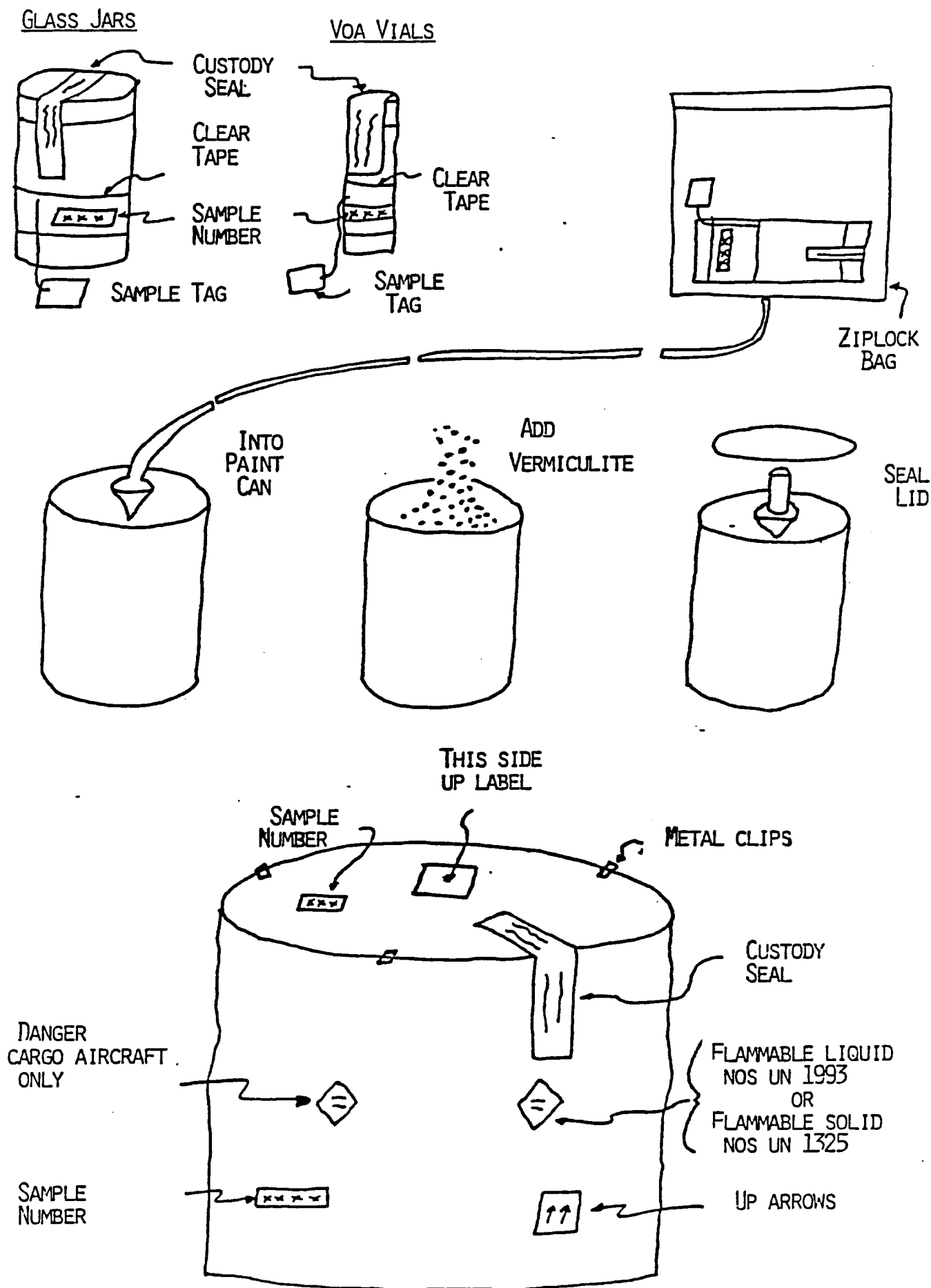
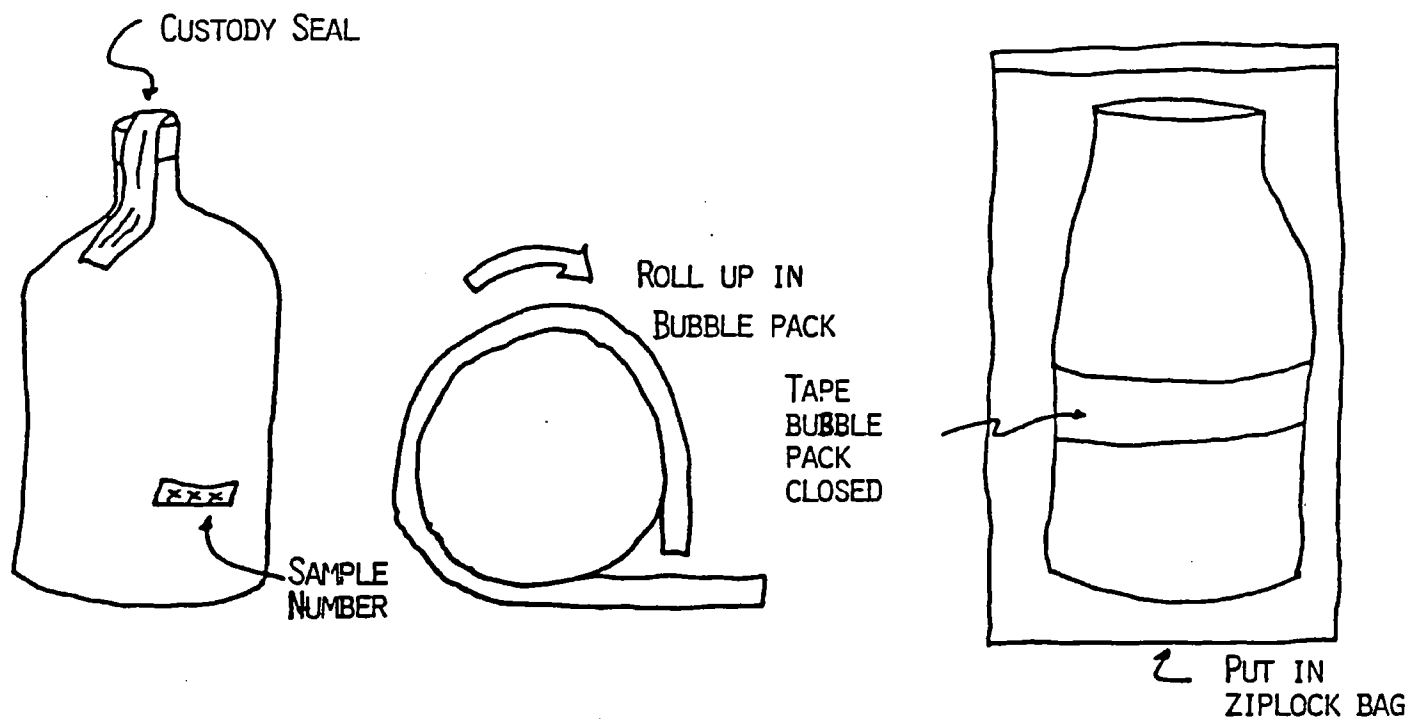
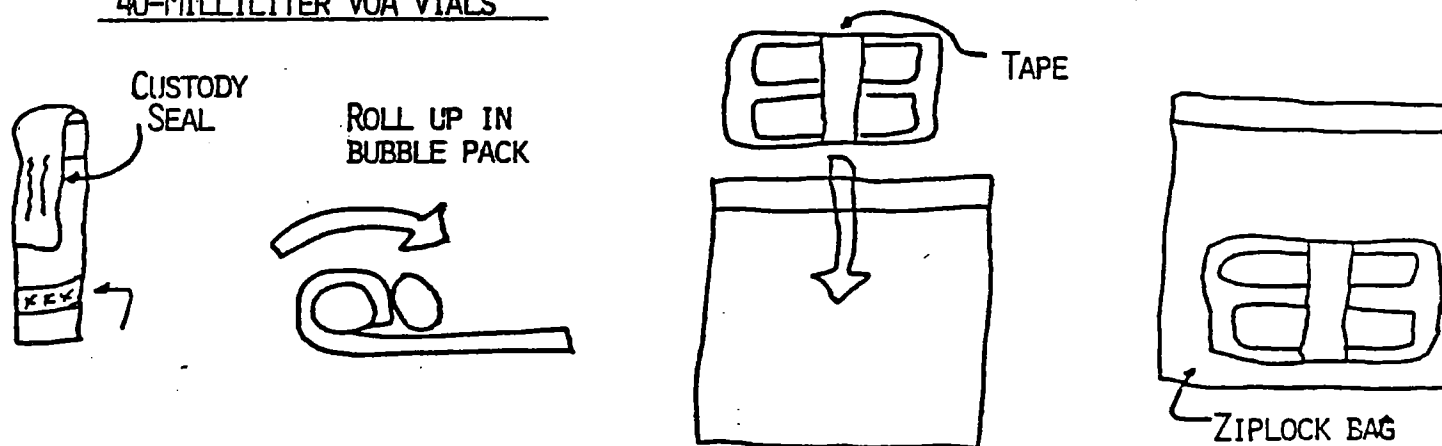


FIGURE 12
MEDIUM HAZARD PACKAGING

1-LITRE AMBER GLASS BOTTLES



40-MILLILITER VOA VIALS



1-LITRE POLYETHYLENE BOTTLES

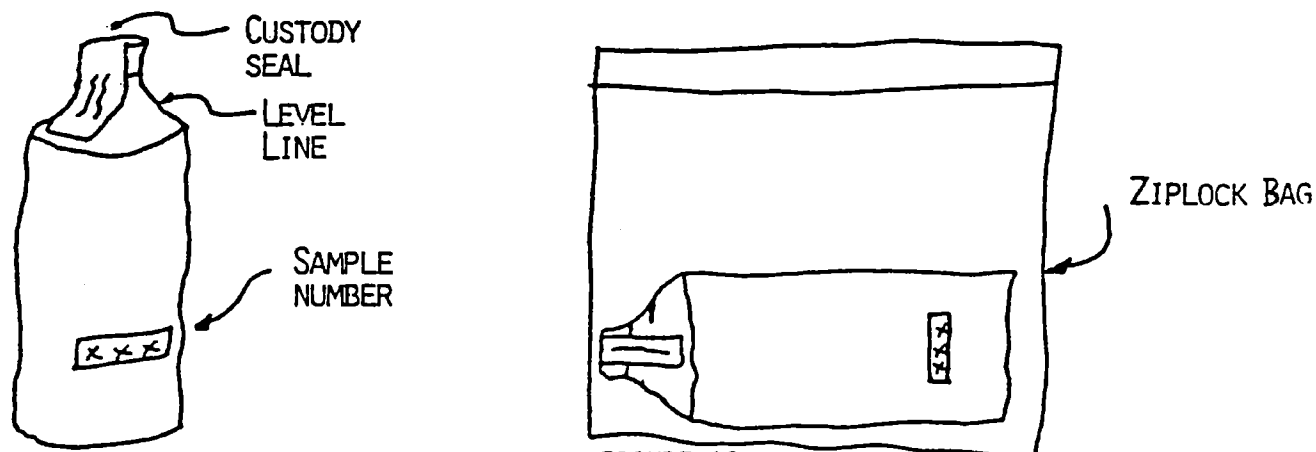


FIGURE 10

PACKAGING PROCEDURE FOR
GROUNDWATER SAMPLES

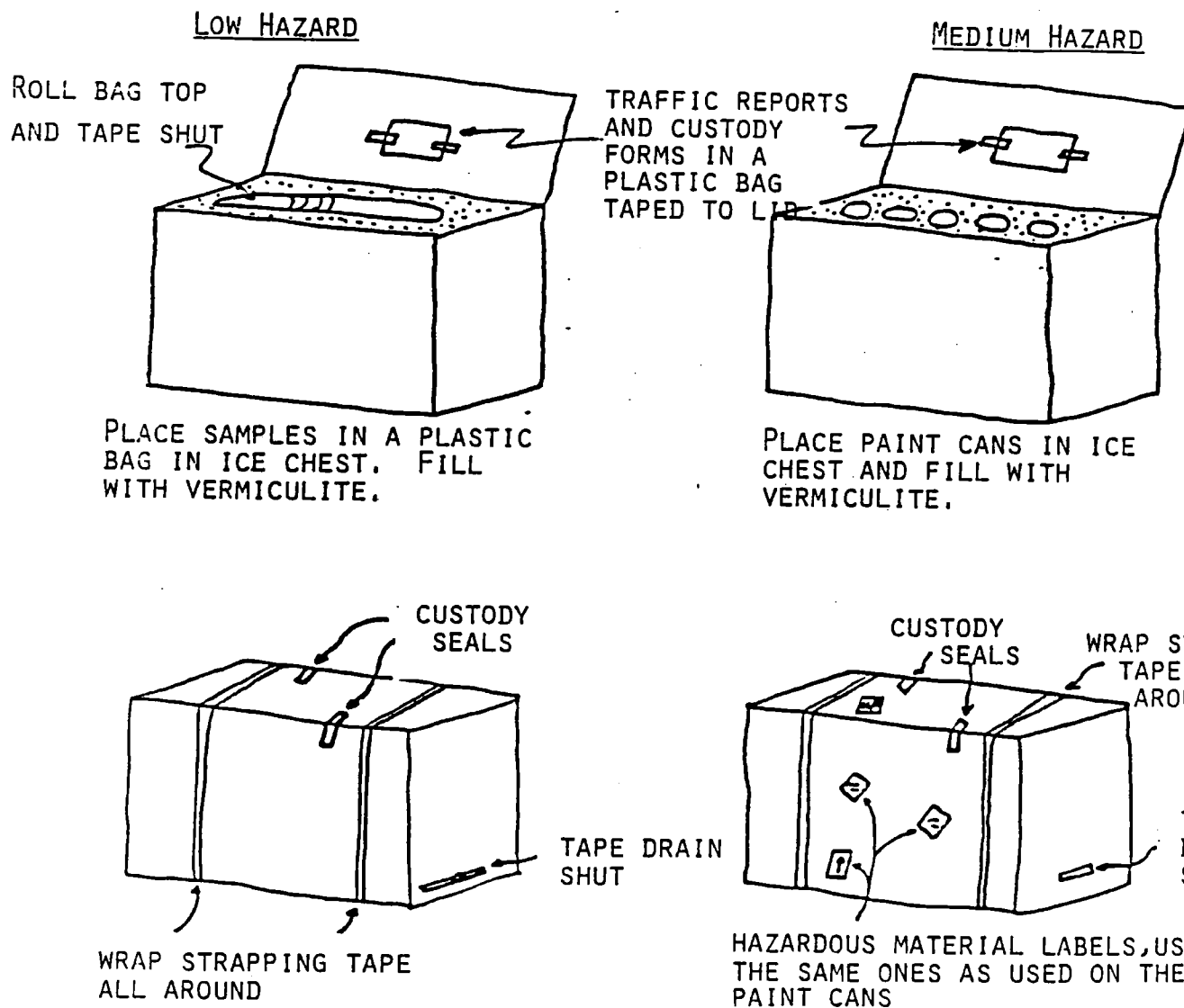
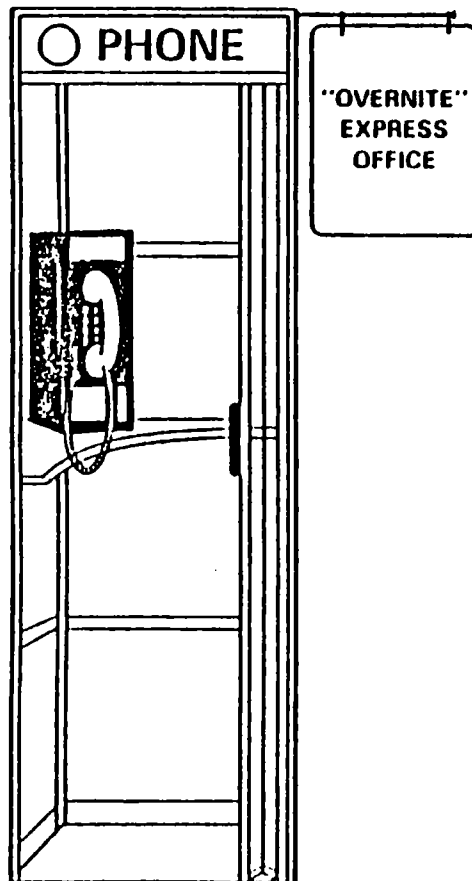


FIGURE 12
PACKAGING PROCEDURE FOR ICE CHESTS

SAMPLE SHIPMENT COORDINATION CHECKLIST



IMMEDIATELY UPON SHIPMENT OF SAMPLES,
SAMPLERS CALL SMO WITH THE FOLLOWING
INFORMATION:

- CASE OR SAS NUMBER
- NAME OF LABORATORY
- DATE OF SHIPMENT
- CARRIER, AIRBILL (SHIPMENT) NUMBERS AND TYPE OF SERVICE
- NUMBER AND MATRICES OF SAMPLES SHIPPED
- INFORMATION ON CHANGES, DELAYS, CONTINUATIONS, ETC., PERTINENT TO THE CASE
- SMO MUST BE NOTIFIED BY 3:00 PM ON FRIDAY FOR SAMPLES INTENDED FOR SATURDAY DELIVERY/PICKUP

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	5
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TOD No.: _____

EPA No.: _____

[illegible]

C-20

General Equipment Checklist

FIELD GEAR TRACKING FORM SITE:	GEAR OUT: GEAR IN:
-----------------------------------	-----------------------

ITEM	QTY-SIZE-TYPE-ETC.
MSA 401	
MSA 401 TANK	
MSA ULTRATWIN	
MSA COMFO II	
MSA CARTRIDGE	
FACE SHIELD	
REGULAR TYVEK	
AIR-COND. TYVEK	
CHEM-KLOS COVERALL	
PROTECTIVE GLOVES	
WORK GLOVES	
BUTYL APRON	
EASTWIND SUIT	
PORTABLE FIRST-AID KIT	
PORTABLE RESPIRATOR	
CASCADE PIGTAIL	
PORTABLE EYEWASH	
WATER COOLER	
ESCAPE CAPSULE	
BOOT COVER	
STRETCHER	
SURGICAL GLOVES	

FIGURE 16

ITEM	QTY-SIZE-TYPE-ETC.
OXY METER	
EXPLOSIMETER	
DRAEGER PUMP	
DRAEGER METER	
RADIATION METER	
pH METER	
MV METER	
ELECTRODE	
S.C.T. METER	
CONDUCTIVITY METER	
pH PAPER KIT	
THERMOMETER	
METAL DETECTOR	
OVA	
HNU	
WELL DEPTH METER	
RADIO	
RADIO ACCESSORIES	
WEATHER STATION	
FLASHLIGHT	
EXTENSION CORD	
TAPE MEASURE	
HAND LEVEL	
COMPASS	
PICK-AXE	

FIGURE 17

ITEM	QTY-SIZE-TYPE-ETC.
GEOLOGIC HAMMER	
SAW	
MACHETTE	
AUGER	
SHOVEL	
pH REFERENCE SOLUTION	
GEOFILTRE PUMP	
GEOFILTRE HOSE	
KEMMERER SAMPLER	
RANGEFINDER	
CAMERA	
8 OZ. JAR	
16 OZ. JAR	
1 LITRE BOTTLE	
1/2 GALLON BOTTLE	
VOA BOTTLE	
ZIP-LOCK BAG	
SMALL PLASTIC BAG	
LARGE PLASTIC BAG	
NITRIC ACID	
SULFURIC ACID	
ZINC ACETATE	
SODIUM HYDROXIDE	
STRAPPING TAPE	
STRAPPING TAPE DISPENSER	

FIGURE 18

ITEM	QTY-SIZE-TYPE-ETC.
PAINT CAN	
GLASS ROD	
POND SAMPLER	
PLASTIC TARP	
BUBBLE PACK	
VERMICULITE	
ROPE	
DISTILLED WATER	
COOLER	
TIMER	
BUCKET	
INDIAN PUMP	
WATER JUG	
KIMWIPE	
SOAP	
SOLVENT	
SQUEEZE BOTTLE	
GARBAGE CAN	
BRUSH	
GARBAGE BAG	
FILM	
PLASTIC BEAKER	
CHAIN-OF-CUSTODY FORM	
INORGANIC TR FORM	
ORGANIC TR FORM	

FIGURE 19

APPENDIX D
QUALITY ASSURANCE PROJECT PLAN (QAPP)

QUALITY ASSURANCE PROJECT PLAN (QAPP)

PROJECT NAME: GREENACRES LANDFILL
GROUNDWATER MONITORING PROGRAM

TDD R10-8408-44

PROJECT OFFICER: RENE FUENTES

QA OFFICER: BARRY TOWNS

PROJECT CODE:

DATE INITIATED:

DATE APPROVED:

APPROVALS:

PROJECT OFFICER

Rene Fuentes

DATE

8 March 1985

QA OFFICER

B. Towns

DATE

3/11/85

1.0 PROJECT DESCRIPTION

1.1 Objective and Scope

Under TDD R10-8408-44, Phase I of the Greenacres Groundwater Monitoring Program involves the installation of 3 monitoring wells to confirm the source and vertical migration of groundwater contamination suspected to originate in the landfill. The wells will be located in an area between the downgradient toe of the landfill and the nearest domestic well. Additionally, an upgradient well will be installed as a comparative control on downgradient conditions. Soil and groundwater samples and water level measurements will be collected during well installation, after development and completion, and on a quarterly basis for a period of one year.

1.2 Data Usage

The data will be used to confirm the landfill as the origin of contaminants found in downgradient wells and aid in the design of a Phase II monitoring well installation program to map the extent of downgradient migration. Both water quality and water level data will be evaluated to make these determinations.

1.3 Sample Collection Design and Rationale

Well locations have been tentatively identified after thorough review of available files and local geologic reports of upgradient and downgradient locations. The final depth of the downgradient wells will be determined in the field by the project manager. Groundwater samples will be collected at various depths during drilling and field screened for the presence of VOCs. Soil samples will be collected from the air-rotary discharge port for soil classification and well logging. After completion of all wells, water samples will be collected and quarterly thereafter for a period of one year. Water level measurements will be made concurrently with sample collection. Sampling procedures are summarized in Section 4.0 of the Sampling Workplan (Appendix C).

2.0 PROJECT ORGANIZATION

Project Manager	<u>John Roland, E&E, FIT Seattle, WA</u>
Project Officer	<u>Rene Fuentes, EPA, Region 10</u>
QA Officer	<u>Barry Towns, EPA, Region 10</u>
Laboratory Support	<u>CLP, EPA Region 10, FIT Field Screening</u>
Data Quality Review	<u>J. Farr, E&E, FIT Seattle, WA</u>

The EPA Contract Laboratory Program and the EPA Laboratory will be used for analysis of groundwater samples collected from the developed wells. Field screening techniques for VOCs will be employed for optimizing the location of well screens in zones of contamination. A Shimadzu GC Mini II operated by FIT chemists will be used.

Glassware has been prepared by the CLP Bottle Repository network. Sample handling requirements are presented in the Sampling Workplan.

4.0 SAMPLING PROCEDURES

Sampling procedures will conform to those specified in EPA Region X Manual of Sampling Hazardous Materials (March, 1983), the Sample Management Office User's Guide to the EPA Contract Laboratory Program (July, 1984), the NEIC Policies and Procedures Manual (May, 1978), and the EPA methods for Investigating Sites Containing Hazardous Substances Technical Monographs (Draft, 1981). These documents specify sampling procedures and equipment for various sampling media and hazardous materials, sample container preparation, and sample preservation methods. Should conditions require any variation from these procedures the attached Sampling Alteration checklist will be used to describe changes from standard procedures.

Sampling sites and depths will be selected to ensure that a representative portion of the sampling media is analyzed. Field sampling will be documented in Field Logbooks maintained by the Field Investigation Team members.

Medium and high concentration hazardous materials samples will not be preserved. No reagents or ice will be used when bottling samples that are suspected to be hazardous. These samples must be packaged and labeled according to Department of Transportation regulations and shipped immediately to the receiving laboratory. Information on preserving environmental samples (collected offsite or where concentrations are reduced by dilution) is presented in the Region X Manual for Sampling Hazardous Materials (March, 1983). Refer to the Sampling Workplan for a detailed description of sampling procedures and analytical requirements.

5.0 SAMPLE CUSTODY PROCEDURES

Although samples collected during these Site Inspections are primarily to be used as screening tools to determine the need for additional sampling, the potential evidentiary nature of the samples requires that the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in enforcement proceedings. The Region X Manual for Sampling Hazardous Materials (March, 1983) specifies the distribution and use of logbooks, sample tags, and chain-of-custody records. Laboratory documentation will follow procedures outlined in the SMO User's Guide to the EPA Contract Laboratory Program (July, 1984). Examples of tags, labels, and standardized reporting forms are found in the Region X Manual for Sampling Hazardous Materials (March, 1983).

SAMPLING ALTERATION CHECKLIST

Site Name: _____ TDD No. _____

Material to be Sampled: _____

Measurement Parameter: _____

Standard Procedure for Sample Collection or Analysis: _____

Reference: _____

Variation from Standard Procedure: _____

Reason for Variation: _____

Resultant Change in Field Sampling Procedure: _____

Special Equipment, Material, or Personnel Required: _____

Investigator's Name: _____ Date: _____

6.0 CALIBRATION PROCEDURES, MAINTENANCE AND FREQUENCY

A water level meter and a salinity/temperature/conductivity meter will be used during sample collection. The specific instrument, manufacturer's operation manual will be followed for maintenance and calibration. The Shimadzu gas chromatograph calibration and operation will be consistent with Shimadzu Corporation Manuals for Gas Chromatograph GC-Mini 2 with Flame Ionization and Electron Capture Detector.

7.0 ANALYTICAL PROCEDURES

The EPA Routine Analytical Services (RAS) program provides laboratory services for uniform and high volume analysis of samples collected during hazardous materials incidents. Laboratories participating in this program are under contract to analyze specified types of samples in accordance with standardized protocols and delivery schedules (SMO User's Guide to the EPA Contract Laboratory Program, July, 1984). As new analytical requirements are identified, the RAS will obtain laboratory services to support the analysis of additional types of samples as well as increasing numbers of samples collected under Superfund and other program activities.

The Special Analytical Services (SAS) program is designed to complement the Routine Analytical Services program by providing the capability for specialized or custom analytical requirements. Sample analyses under the SAS program are performed by laboratory currently in the Contract Laboratory Program (CLP) and are subject to the same quality assurance and document control requirements stipulated for standardized analyses.

The EPA Region X Laboratory utilizes EPA Test Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA-600/4-82-057) and Test Methods for Evaluating Solid Wastes (EPA SW 846-1980) following SMO guidelines for data quality assurance and document control.

Analytical procedures for operation of the Shimadzu GC for field screening VOC-contaminated water and soil samples are being developed under E&E TDD No. R10-8410-01.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

All samples will be promptly packaged and shipped according to Department of Transportation regulations to a contract laboratory specified by the EPA for analytical services. By utilizing program procedures and resources, all sampling logistics, tracking documentation and final data formats will be consistent and parallel. Exceptions to this mechanism may arise if space is not available within the CLP to handle the proposed load. In this event, samples will be preserved by the appropriate collection preservation technique until the analyses can be run.

All samples will be accompanied by a Field Data Sheet and a copy of the Chain-of-Custody record. Samples destined for the EPA lab will also have Analysis Request forms. Forms will be sealed inside ziplock bags and taped to the inside lid of the shipping container. In addition, field notes and Field Data sheets will be used to document sampling activity. All sample analyses will be provided to J.E. Osborn FIT RPO, Field Operations Branch, EPA Region X. Summary reports will document sampling methods, locations, and site-specific requirements.

9.0 INTERNAL QUALITY CONTROL CHECKS

The Region X Field Investigation Team will follow guidelines established in the Region X Manual for Sampling Hazardous Materials (March, 1983) and the EPA Handbook for Analytical Quality Control in Waste and Wastewater Laboratories (March, 1979), regarding the responsibilities of field personnel for the collection of quality control samples. Internal quality control within the laboratory will follow recommendations of the EPA handbook referenced above and the SMO User's Guide to the EPA Contract Laboratory Program (July, 1984).

Duplicate field samples, transfer blanks, transport blanks, and background samples will be collected as necessary to verify sample quality as outlined on page 18 of the SMO User's Guide to the EPA Contract Laboratory Program (July, 1984). Spiking of samples to measure changes during shipping or to assess laboratory accuracy is not anticipated. Sample blanks will be prepared routinely and used to measure contamination of sample containers during shipping and handling.

Preservatives will generally not be used for inorganic parameters. Refrigeration of samples will be used for soils and organic parameter water samples where conditions and sample characteristics permit.

10.0 PERFORMANCE AND SYSTEM AUDITS

Regional EPA laboratories or contract facilities used by FIT personnel are required to take part in a series of performance and system audits conducted by the National Enforcement Investigations Center (NEIC). Laboratory quality control data and performance evaluations will be submitted along with analytical results for assessment by program reviewers.

Performance and system audits for FIT sampling operations will consist of onsite reviews of field quality assurance systems and equipment for sampling, calibration, and measurement consistent with the Zone II REM/FIT Quality Assurance Manual (Contract No. 68-01-6682). The program Quality Assurance Coordinator will develop and conduct system audits based on the approved project plan. Audits will follow guidelines provided by the NEIC for performing audits of field activities.

11.0 OBJECTIVES AND ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Measurement parameters vary widely depending upon the site, the type and concentration of material, and the media to be sampled. Precision and accuracy will be evaluated by sampling teams and QA data reviewers as per guidelines given in "Procedure for the Evaluation of Environmental Monitoring Laboratories" (EPA 600/4-78-017 March 1978) and "Manual for the Interim Certification of Laboratories Involved in Analyzing Public Drinking Water Supplies and Procedures" (EPA 600/8-78-008 August, 1978). In all instances representativeness and comparability of data will be assured following the sampling procedures detailed in Region X Manual for Sampling Hazardous Materials (March, 1983) and the Zone II REM/FIT Quality Assurance Manual.

Because the sampling objectives are screening in nature and the grab sampling is limited in scope it is not felt that statistical analyses or significance testing will be required. Quality assured analytical results will be compared to established guidelines, standards, and criteria for interpretation.

12.0 CORRECTIVE ACTION

Corrective action will be taken by the Field Investigation Team when data are found to be outside the predetermined limits of acceptability. In most instances, corrective actions will be initiated by the program Quality Assurance Coordinator. Prior to undertaking corrective actions, remedial plans should be reviewed and approved by the FIT RPO. The EPA Region X Quality Assurance Officer may be consulted if means of correcting data quality problems are not clear.

Corrective actions may also result from field performance and systems audits. If audits reveal problems in maintenance of data quality; the person responsible for initiating the actions, the actions themselves, and the individual responsible for approval will be identified.

13.0 QUALITY ASSURANCE REPORTS

Reports to J.E. Osborn, FIT RPO, regarding the status of quality assurance activities for FIT sampling will be submitted on an as requested basis throughout the Site Inspections. Site Inspection reports will contain current information regarding data accuracy, precision, and completeness for specific sites. Results of systems and performance audits will be presented along with significant quality assurance problems that arise during the project period in an independent report, if necessary. Recommended solutions to the problems and corrective actions will be discussed. Quality assurance reports will be prepared by the project's respective Project Managers.